



Proposed Updates

Vehicle Frontal Protection Systems - Construction Guidelines

Introduction

In this document, the term Frontal Protection System (FPS) includes Bull Bars, Roo Bars and Nudge Bars.

The purpose of this Circular to Industry (CI) is to define a West Australian (WA) Department of Transport (DoT) standard for FPS which informs manufacturers and retailers about the safety requirements applying to the design, specification and fitment of FPS to vehicles on WA roads.

This standard provides an appropriate balance between the protection of vehicle occupants from animal strike and the safety of pedestrians by offering clear guidance to help ensure that the right FPS is fitted to the right vehicle in the right way.

From *Date*, any FPS newly fitted to a vehicle in WA must comply with the requirements detailed in this CI. By *Date + X years*, all vehicles in WA fitted with an FPS must comply with this CI.

Background

For many years, an FPS has been accepted as an accessory for most types of vehicle, often fitted to help protect a vehicle in the event of a crash with an animal, such as a kangaroo, by reducing the potential for damage to the cooling system and leaving the vehicle stranded after an impact. An FPS also helps provide additional frontal protection from scrub and bushes when driven off-road on overgrown bush tracks.

However, when a poorly designed FPS is fitted to a vehicle, it can be potentially dangerous to vulnerable road users such as pedestrians and cyclists in the event of a collision. In addition, the continued development of vehicle technology and ongoing improvements in vehicle safety systems have led to a situation whereby the fitment of a FPS may actually interfere with the sophisticated safety systems designed into modern vehicles.

A great deal of research has been conducted into the possible effects of an FPS in a collision and ways of optimising their design.

This DoT document has been produced following detailed technical investigations. It supports and builds upon the information contained within Australian Standard AS 4876.1-2002 *Motor vehicle frontal protection systems Part 1: Road user protection*, which primarily addresses the issue of minimising the risk of injury to pedestrians as a result of colliding with a vehicle fitted with an FPS.

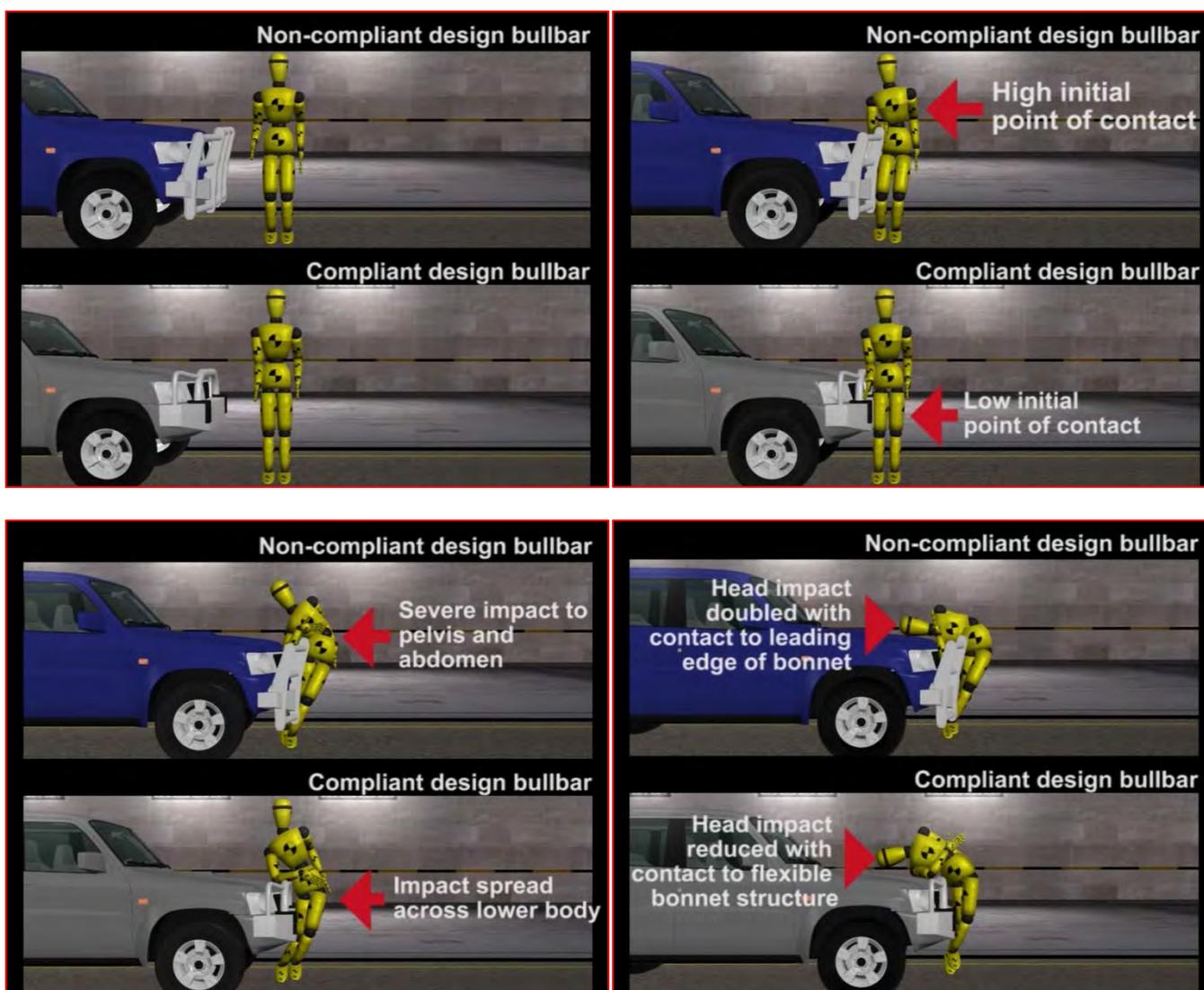
Pedestrian Safety

Accident statistics, confirmed by scientific studies, have shown that a badly designed FPS greatly increases the risk of injury to a pedestrian hit by a car, even at relatively low speeds.

Generally the best scenario for the pedestrian, and when the severity of injury is minimised, occurs where the pedestrian rolls onto the bonnet of the car. The chances of this happening are better if the point of initial contact between car and pedestrian is as low as possible. One of the risks posed by a badly designed FPS is that it will raise the point of initial contact and thereby increase the severity of a pedestrian injury.

For vehicles fitted with an FPS, laboratory testing has confirmed the importance of FPS design to the outcomes of a pedestrian collision. The images below, taken from a computer simulation conducted by the Centre for Automotive Safety Research (CASR) at the University of Adelaide demonstrates that a compliant FPS results in lower pedestrian head impact speeds with the vehicle, reducing the severity of the impact and resulting in a reduction to the risk of a serious head injury by well over 50%.

Because the non-compliant FPS presents a higher point of initial contact, the pedestrian is pushed forward and bent around the top of the FPS, rather than being swept onto the bonnet of the car, resulting in a much higher risk of spinal, pelvic and head injuries to the pedestrian, even at relatively low collision speeds.



Vehicle Occupant Safety

Over the last few years, there have been significant advances in the on-board safety systems fitted to new vehicles. The continued development of vehicle technology and ongoing improvements in vehicle safety systems have led to a situation whereby the fitment of an FPS may actually interfere with the sophisticated safety systems designed into modern vehicles.

The main causes of concern are outlined as follows:

- Incompatibility with Vehicle Air Bags

A badly designed FPS may affect the triggering of the airbag sensors in the event of a crash, causing the air bags to activate at the incorrect time. In the worst case, this can cause significant additional injury to the occupant.

- Nullification of Crumple Zones

Modern vehicles have crumple zones that protect the occupants by cushioning the impact of a front-end collision. A badly designed FPS has the potential to make the front end of the vehicle significantly more rigid, thereby nullifying the effect of the crumple zones. This causes a more severe impact for the occupants of all vehicles involved.

- Incompatibility with Other Vehicles

At an international level, significant research is being undertaken towards improving the “crash compatibility” between vehicles involved in vehicle-to-vehicle collisions. The aim of this research is to design vehicles in such a manner that maximises each vehicle’s ability to absorb crash energy. A badly designed FPS can negate these design features, thus increasing the risk of more significant injuries to the occupants of other vehicles involved in the collision, than would have been the case had the colliding vehicle not been fitted with a FPS.

ANCAP Safety Rating of a Vehicle fitted with an FPS

Research tests have shown that an FPS can adversely affect performance in the ANCAP frontal offset test - increasing the risk of injury to occupants. In modern vehicles, the front crumple zone is usually an optimum design for this severity of crash and an FPS can change the crumple characteristics away from this optimum.

The fitting of an FPS also increases the potential risk of injury to pedestrians. From 2012, the ANCAP Road Map sets out minimum requirements for pedestrian protection in order for a vehicle to receive an overall rating of 5 stars.

Certain vehicle manufacturers now produce an FPS that, when fitted to a specific vehicle, maintains that vehicle’s 5 star ANCAP safety rating.

DoT recommend that, prior to purchasing any FPS, confirmation is received from the manufacturer or supplier that the ANCAP rating of the vehicle will not be degraded by fitment of the FPS.

FRONTAL PROTECTION SYSTEMS FOR LIGHT VEHICLES

This section applies to vehicles with a gross vehicle mass (GVM) of no greater than 4.5 tonnes.

Every FPS must be designed to minimise

- the risk to pedestrian safety, and
- the likelihood of penetrating into other vehicles in the event of a crash,

by adhering to the following guidelines:

Initial Point of Contact

The position of the initial point of contact of the FPS with a pedestrian must not be raised from that on the vehicle when no FPS is fitted.

The top of the FPS should not protrude above the leading edge of the bonnet.

Examples of acceptable FPS designs are shown below;



Determination of the leading edge of the bonnet

The “leading edge of the bonnet” is the higher of either:

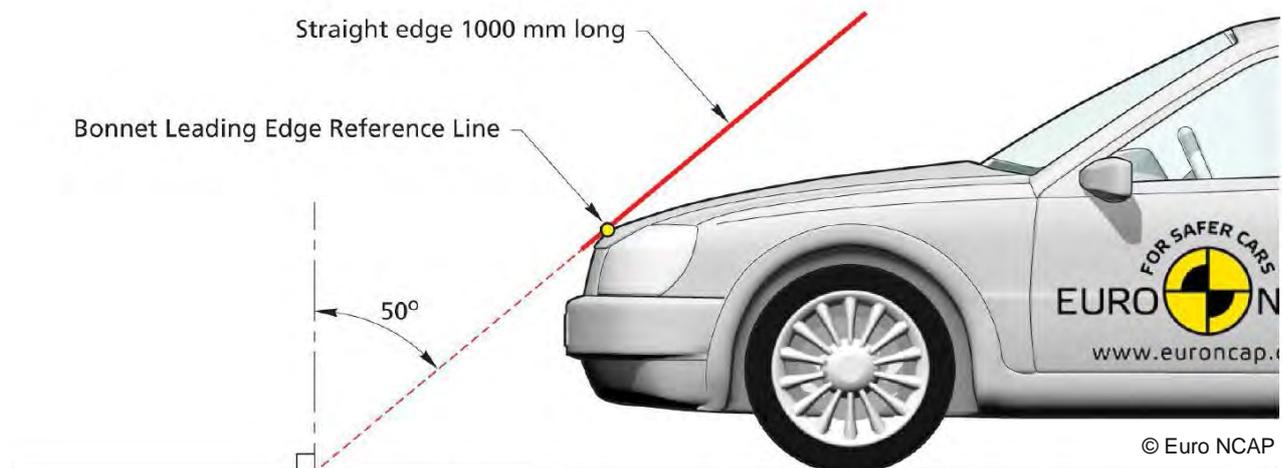
- the point of maximum curvature around which the pedestrian’s body would rotate in the event of a collision, or
- the front edge of the bonnet.

The highest point of an FPS must not be higher than the leading edge of the bonnet.

Examples of the leading edge of the bonnet are shown below;



Additional clarification is provided in the Euro NCAP Pedestrian Testing protocol v8.3 (Dec. 2016, P.14) which defines the “Bonnet Leading Edge Reference Line” as shown below.



Determination of the Bonnet Leading Edge Reference Line

The above definition is as provided in UNECE Regulation 78/2009 which lays down requirements for the construction and functioning of motor vehicles and frontal protection systems in order to reduce the number and severity of injuries to pedestrians and other vulnerable road users.

FPS to follow frontal profile of the vehicle

To minimise the risk of increased pedestrian injury, the whole FPS must conform to the frontal profile of the vehicle to which it is fitted.

Put simply, the FPS must follow the shape, in plan view, front view and side view, of the front of the vehicle.

The side profile of the FPS must not be any steeper than the side profile of the front of the vehicle.

The FPS must not lean forward.

Examples of acceptable FPS designs are shown below;



The maximum distance from the leading edge of the bonnet to the inside of the FPS should not exceed 200mm

Dangerous Projections

Existing provisions in the *Road Traffic (Vehicle) Regulations 2014*, relevant to FPS design, prohibit dangerous projections and sharp corners. The FPS must be designed so as to prevent the hooking or grazing of other road users:

- Exposed edges need to be chamfered and free of burrs or sharp edges
- Forward facing edges must have radii not less than 5mm
- Open ended frame members are not permitted

Where the front bumper of the vehicle is removed to allow an FPS to be fitted, the design of the FPS must not cause any dangerous projections by exposing edges and components previously masked by the OEM bumper bar or air dam / spoiler.

An example of an exposed edge creating a dangerous projection is shown below;



To provide clarity in determining what constitutes a dangerous projection, the following methodology, taken from UNECE Regulation 26 - "*Uniform provisions concerning the approval of vehicles with regard to their external projections*", is to be adopted ¹.

As per the provisions of Regulation 26, a dangerous projection is defined as any part of the external surface which, with the vehicle in the laden condition, with all doors, windows and access lids etc., in the closed position, is:

1. Above the floor line, and
2. At a height of no more than 2 metres, and
3. So located that, in its static condition as well as when in operation, it can be contacted by a sphere 100 mm in diameter."

¹ With the end of Australian vehicle manufacturing in October 2017, the process of adopting UN Regulations into ADR requirements will accelerate

Attachments and Attachment Points on an FPS

It is acceptable to have attachment points fixed to an FPS for items such as aerials and driving lights provided they are only fixed to the rear of the FPS in a manner that prevents them from becoming dangerous projections.

Similarly, fishing rod holders may only be fitted if they do not protrude forward of the front face or above the top bar of the FPS to which they are fitted and do not become a dangerous projection.

Examples of acceptable attachment points on an FPS are shown below:



A rod holder mounted as shown below is a dangerous projection and is not acceptable.



Vehicle Lighting

The installation of an FPS may result in the existing lighting being obscured and consequently prevent the vehicle from complying with ADR 13 - *Installation of Lighting and Light Signaling Devices on other than L-Group Vehicles*.

Where ADR lighting requirements are not satisfied, additional lamps must be fitted so that the vehicle complies.

Original lamps that seem to be obscured but pass a scientific test proving ADR compliance will be accepted upon presentation of the relevant test results. All additional lamps shall comply with the relevant ADR's.

Examples of acceptable additional lighting on an FPS are shown below:



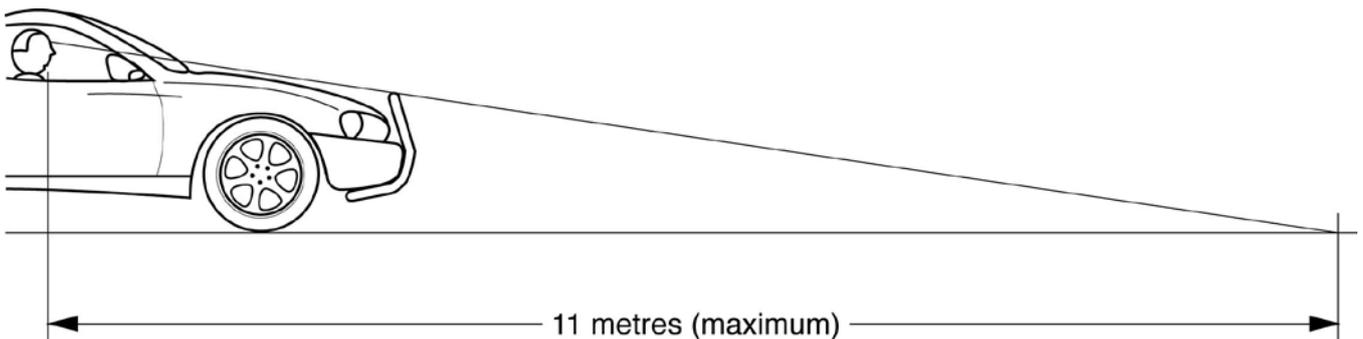
Field of View

Any FPS, together with any attachments, must not reduce a driver's ability to safely drive the vehicle to which it is attached.

When sitting in the driver's seat with the seat located at its rearmost position, it shall be possible to see the surface of the road 11 metres in front of the driver's eye looking across the top of the FPS as shown below.

For the purposes of this requirement, the driver's eye position can be taken as being a point 730mm above and 270mm forward of the junction of the seat cushion and squab (back) with the seat in its lowest and rearmost position;

Driving lights and other accessories that will obscure the driver's field of view must not be attached to the top rail of an FPS.



Field of View

Front Axle Load Rating

The maximum front axle weight of the loaded vehicle fitted with an FPS and any accessories must not exceed the manufacturer's front axle load rating.

Manufacturer's Safety Equipment

Any FPS fitted to a vehicle must not interfere in any way with the operation of any safety features fitted to the vehicle by the vehicle manufacturer.

Continued compliance with all Federal and State requirements

Any vehicle fitted with an FPS must continue to comply with all applicable Australian Design Rules and State requirements.

Approval Requirements

Any FPS that complies with the requirements of this CI is considered to be an acceptable vehicle modification that does not require the owner of the vehicle to obtain a "Modification Permit" from the Department of Transport (DoT). Manufacturers or suppliers who fit a complying FPS therefore do not need to seek prior approval before fitting these to road vehicles.

Any FPS that does not comply with this CI will be required to be removed from the vehicle.

If there is any doubt that the fitment of a particular FPS design may not comply with this CI, suppliers or manufacturers must contact the *Vehicle Safety and Standards Section* of DoT before fitting the FPS.

If the application is considered to be acceptable, given the particular circumstances, the FPS installation may be approved, or the design itself may be approved for use on certain vehicles.

Selection of a suitable FPS

When purchasing an FPS, consumers are strongly advised to select a design of FPS that not only meets the design requirements of this CI, but which is suitable for their driving requirements.

A style of FPS such as a nudge bar (below, left), and especially those made of plastic or coated with cushioning material, are typically smaller than a full bar (below, right), change the front of the car less and may be more compatible with airbags and other safety features.



On-road enforcement officers will issue a defect notice to a vehicle fitted with an FPS that does not comply with the requirements of this CI.

Fitment of FPS to ADR 69/ and ADR 73/ Vehicles

Australian Design Rule ADR 69/ and ADR 73/ set minimum levels of occupant protection, as determined by crash testing. Depending on the design and application, an FPS may positively or negatively affect occupant safety in a crash situation.

ADR 69/ affects the following vehicles:

- from 1 July 1995, all new model MA vehicles (passenger cars), and
- from 1 January 1996, all MA vehicles (passenger cars), and
- from 1 January 1998, all new model MB vehicles (forward control passenger vehicles), and all new model MC vehicles (off-road passenger vehicles), and
- from 1 July 1998 for new model NA1 vehicles (light goods vehicles), and
- from 1 January 2000 all MB vehicles (forward control passenger vehicles), and all MC vehicles (off-road passenger vehicles), and
- from 1 July 2000 all NA1 vehicles (light goods vehicles).

ADR 73/ affects the following vehicles:

- from 1 January 2000, all new model MA vehicles (passenger cars); and with a Gross Vehicle Mass (GVM) of less than 2.5 tonnes, and
- from 1 January 2004, all MA vehicles (passenger cars); and with a GVM of less than 2.5 tonnes.

For these vehicles, FPS manufacturers will need to provide evidence that the fitment of their product does not interfere with the intent of the occupant protection provisions specified in ADR 69/ and ADR 73/. (e.g. by conducting physical tests or computer simulations).

Air bags may be fitted by vehicle manufacturers in order to comply with ADR 69/ and ADR 73/ or as an additional safety feature at the manufacturer's discretion. The triggering methods used to deploy the air bags vary greatly in complexity between manufacturers. The fitting of an FPS to the front of a vehicle may have an unknown effect on the deployment characteristics of an air bag. FPS manufacturers will need to demonstrate that the fitment of their product does not adversely interfere with the triggering of the air bag system.

Research to date indicates that the strength of the mounting points is one of the most significant parameters of the FPS's potential to interfere with the vehicle's crashworthiness. The research has shown that carefully designed mounting points result in little or no effect on the vehicles ability to satisfy ADR 69/ and ADR 73/.

FPS manufacturers should acquaint themselves with this information and ensure that their FPS designs comply with these requirements. Manufacturers should utilise the services of a professional engineer if required to assist them in interpreting this data and applying it to their designs.

If the FPS can be fitted with additional bush-rails / scrub bars, then any testing undertaken should include their fitment.

FPS Labeling (other than OEM bars)

Every conforming FPS shall have a durable plastic or metal plaque permanently attached by bonding, riveting, welding, drive screws, or a durable integral label, on a surface of the bar such that the label can be read when the FPS is attached to a vehicle and located where it will not sustain environmental damage.

It shall display the following information in permanent and legible letters not less than 4 mm high:

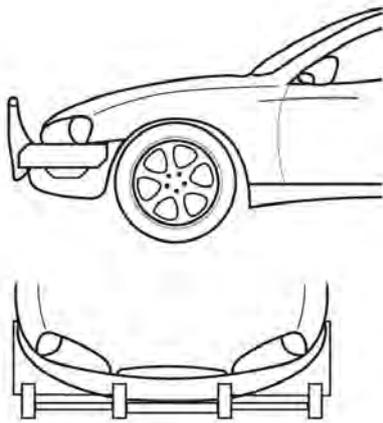
- A description indicating the vehicle make and year model(s) for which the FPS is suited

- The FPS manufacturer's business name
- An identification code that permits the manufacturer (or importer) to identify a specific production batch
- The statement "This product and the associated fixings must not be modified"
- A statement to confirm that the vehicle continues to comply with all applicable ADRs[#].
eg ADR 13/-, ADR 42/-, ADR 69/-, ADR 73/-

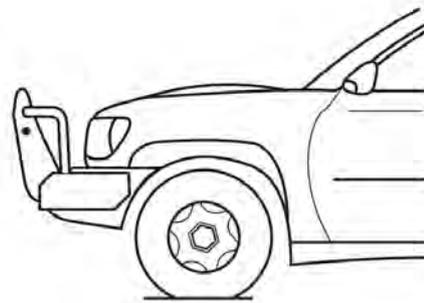
[#] As per the requirements of the *Road Traffic (Vehicles) Regulations 2014 Part 10 Division 4 – Compliance with Australian Design Rules*

Non-Compliant FPS Designs

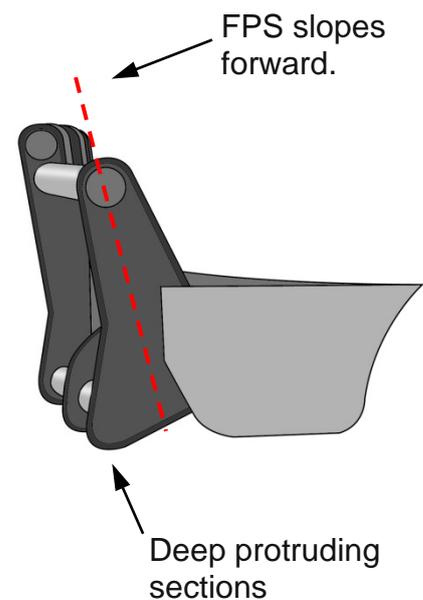
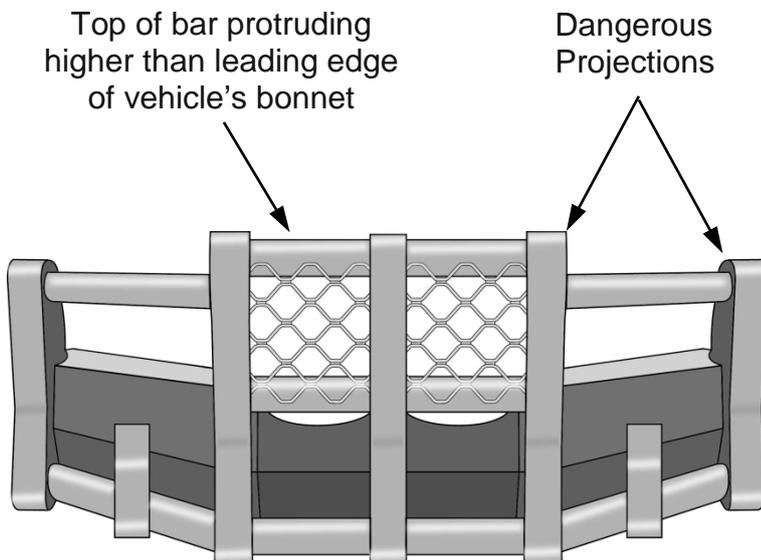
The following FPS designs do not meet the requirements of this CI.



FPS does not follow profile of front, is too high



FPS leans forward, is too high



FRONTAL PROTECTION SYSTEMS FOR HEAVY VEHICLES

In considering the design and construction of an FPS for a heavy vehicle, the design principles detailed above for light vehicles should be applied wherever possible.

The use of innovative design to produce a lighter, less-aggressive bar, in addition to improving pedestrian protection, may also result in increased safety for the occupants of another vehicle in the event of a crash.

Less aggressive truck bars will contribute significantly in reducing the likelihood of the “can opener effect” in the event of an impact with the side of another vehicle by having large radii on the top leading corners of the bar.

Examples of acceptable FPS designs are shown below



Non-Compliant FPS Designs

The following FPS designs do not meet the requirements of this CI.

FPS leans forward, deep protruding front, sharp edges, open members.



FPS leans forward.



FPS leans forward, open members



Fitment of FPS to ADR 84/ Vehicles

ADR 84/ affects the following vehicles:

- from 1 January 2011, all new model NC vehicles (heavy goods vehicle with GVM over 12 tonnes)
- from 1 January 2012, all NC vehicles

In addition, from 1 January 2011, ADR 84 is optional for NB2 vehicles (medium goods vehicles with GVM over 4.5 tonnes up to 12 tonnes).

The introduction of ADR 84-*Front Under-run Impact Protection* (FUPS) needs to be taken into consideration, including vehicles fitted with FUPS prior to the introduction date.

FPS manufacturers will need to provide evidence that the fitment of their product to a vehicle fitted with FUPS does not interfere with the intent of the provisions specified in ADR 84/. (e.g. by conducting physical tests or computer simulations).

FPS manufacturers should acquaint themselves with this information and ensure that their products comply with these requirements. Manufacturers should utilise the services of a professional engineer if required to assist them in interpreting this data and applying it to their designs.

FPS manufacturers will also need to demonstrate that the fitment of their product does not adversely interfere with the triggering of any air bags system fitted to the vehicle (if applicable).

Labeling for other than OEM bars

Conforming bars shall have a durable plastic or metal plaque permanently attached by bonding, riveting, welding, drive screws, or a durable integral label, on a surface of the FPS such that the label can be read when the bar is attached to a vehicle and located where it will not sustain environmental damage.

It shall display the following information in permanent and legible letters not less than 4 mm high:

- A description indicating the vehicle make and year model(s) for which the FPS is suited
- The FPS manufacturer's business name
- An identification code that permits the manufacturer (or importer) to identify a specific production batch
- The statement "This product and the associated fixings must not be modified"
- A statement to confirm that the vehicle continues to comply with all applicable ADRS eg ADR 13/-, ADR 84/-

FPS in conjunction with other vehicle modifications

An FPS, that is compliant when fitted to an unmodified vehicle, may no longer comply if the vehicle is subsequently modified.

For example, the combined effect of a vehicle suspension lift and fitment of a FPS may compromise compliance with ADR requirements for wheel coverage.

Please contact DoT's Vehicle Safety & Standards section if you require any further advice on fitting an FPS to a modified vehicle



Prepared by:

Department of Transport
Vehicle Safety and Standards

Document History (Version control)

Version No.	Date	Prepared by	Revision or issue description	Issued to
CI-1995-200	May 1995	VSB	Initial Release	
CI 1995-201	Mar 1998	VSB	Additional photos / diagrams added	
C112-A	Nov 2003	VSB	New DPI format	
C112-B	July 2005	VSB	Additional diagrams added	
C112-B	June 2010	VSS	New DoT format	
C112-C	May 2015	VSS	Contact details updated	
	Sept 2017	VSP	Content review. New DoT format	Draft